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GLACIAL STUDIES IN GREENLAND. III.

COAST GLACIERS BETWEEN DISCO ISLAND AND INGLEFIELD GULF.

FROM the southern extremity of Greenland to the vicinity of Upernivik the ice-cap lies so far inland as to be but rarely and imperfectly seen from a coasting vessel. Here and there it forms the sky line between the mountains, and at intervals tongues push down the valleys to the inner coast line, but only such fragmentary views are offered to the passer-by. Even for a degree and a half beyond Upernivik, little may be seen of the interior ice-field, though nothing but a coastal fringe of islands intervenes. The Devil's Thumb, that grewsome landmark of the navigator, which stands over against the dreaded ice pack of Melville Bay, must be passed before the border of the great ice-field comes fairly into view.

It may be recalled that from Cape Farewell to the Devil's Thumb the coast has a mountainous aspect interrupted at intervals by lower tracts of fluent contours. Its general expression is harsh and rugged. Patches of snow and local glaciers give it an Arctic aspect; still it is more nearly ice-free land than an ice-field. It is a black-and-white border to the great white interior. Near Upernivik this border becomes reduced to a fringe of mountainous islands. These disappear near Lat. 74° 30′, and the great ice cap comes out to the coast and by its precipitous ice-walls forms the sea border. The Devil's Thumb, situated on one of the most northern of these bordering islands, becomes the sentinel of the transition from the one type of coast to the other. It is a columnar monument of rectangular aspect surmounted by a more slender column, not altogether unlike the combination of the Auditorium tower, if a local comparison may be permitted. A resemblance to his majesty's opposable digit would never have occurred to me, but this may be due to a lack of personal acquaintance. There was certainly also a lack of suggestive associations; for as a relatively slender column standing only a few miles from the edge of the great ice sheet it awakens in the glacialist thoughts lying in quite opposite thermal relations. What does this column so situated signify respecting the former extension of the ice? There are better reasons than the temperature associations of his majesty for thinking that the ice may never have passed over the Thumb since its isolation. Without fuller knowledge, however, there is an open alternative between the view that exfoliation has developed the monument out of a peak or promontory since the ice passed over it and the view that the ice never advanced so far. Melville Monument, a somewhat similar rocky column rising out of the bay off the face of the ice border a degree farther north, presents a similar alternative, as do also some of the rather rugged islands along the coast, though the majority of these are fluent in contour, and carry implications of precisely the opposite kind.

Beginning just beyond the Devil's Thumb, at about latitude 74° 30′, the coast of Melville Bay, for about 150 miles, is formed much more largely of ice than of land. A survey has recently been made by Mr. Astrup, of Lieutenant Peary's party, which will, when published, add greatly to the existing knowledge of this remarkable coast, which is laid down on our charts with confessed inaccuracy. Not to anticipate this, it may be safely affirmed, on the basis of passing observation, under the favorable conditions of our voyage, that while the coast is not the uninterrupted ice-wall that sailors sometimes represent it (due, perhaps, to the deceptiveness of its frequent and phenomenal mirages) its most dominant and interesting feature is the edge of the great ice-field broken into vertical sea cliffs as it pushes out into the margin of the bay. These cliffs, though very extended, are not wholly continuous. They are occasionally interrupted, not only by promontories standing forth from the base of the ice slope like dormer windows at the eaves of a roof, but also by lower areas whose freedom from ice is less obviously due to altitude. These interruptions, however, are usually limited in extent. The promontories are closely girt about by ice on their sides and in the rear, and lack only enclosure on the sea face to reduce them to typical nunataks. Indeed, many of the prominences that lie a little back from the coast are thus completely surrounded, and present excellent types of islands in the ice, the Greenlander's nunataks.

From a vessel sailing some distance off the shore (and the broad foot of stationary bay ice rarely gives a ship any other privilege), a considerable tract of the upper slope of the glacier is visible. The sky line lies some miles inland. Only a few of the promontories on the coast rise high enough to be projected across this sky line and interrupt the otherwise continuous stretch of the glacial horizon. The ice does not meet the sky in a simple straight line. It undulates gently, indicating some notable departure of the upper surface of the ice tract from a plane. As the ice-field slopes down from the interior to the border of the bay, it takes on a still more pronounced undulatory surface. It is not unlike some of our gracefully rolling prairies as they descend from uplands to valleys, when near their middle-life development. The convexities are much broken by crevasses. It is not a few gaping fissures here and there, or even at regular intervals, but an intimate cracking open of the whole convex surface, so as to alter its entire expression. As a result, the light reflected from the crevassed portions is brighter than that from the smoother parts, and the undulations are thus set forth delicately but very expressively by the varying tones of the nearly white light. The intimacy and extent of the crevassing on the swelling surfaces is quite remarkable when the relative slightness of their convexities, the breadth and freedom of the sheet, and the evident slowness of motion are considered. The slowness of motion is safely inferred from the limited amount of surface wastage during the short season, and the very moderate iceberg product in proportion to the vast frontage. The undulations are undoubtedly due to the inequalities of the rock surface below. The first impression is that the ice sheet is quite thin and altogether subservient to the basal irregularities. And this is doubtless measurably true. But it appears also to be an expression of brittleness rather than of viscidity, as a property of the ice. Its competency to stretch must be very slight. The degree of undulation also shows a feebleness of adaptive fluency.

The surface of the ice seemed to be wholly free from rocky débris save where contact with promontories or nunataks give rise to trivial moraines. Except for these the bay ice seemed no more free of débris than the surface of the glacier. The descent from the sky line to the sea wall must be some 3000 feet, and yet it would appear that no material is brought from the base to the summit. The exposed portions of the icebergs of the region are usually quite free from débris. In a few instances interbedded earthy layers were observed.

A considerable number of icebergs were scattered along the front of the sea wall, held fast within the sheet of bay ice that still remained stationary. In the moving portion of the ice pack comparatively few were seen. It is obvious that the icebergs enclosed within the stationary ice embraced all those that had been discharged since its freezing, which was at most not more recent than the previous fall; indeed, they probably embraced not a few that had been discharged much previous to that, for many of them appeared to be aground, and to have been subjected to considerable wastage since they had been discharged. Large numbers of icebergs were aground on the shallows near Cape York and along the face of the Crimson Cliffs. Captain Nares expresses the opinion that these bergs originated in Melville Bay and were carried westward by the tide, which, coming from the south, is turned to the west by the concave contour of the bay. If this be true, perhaps it should increase somewhat our estimate of the discharge from the Melville ice wall, but the fact that they are aground and wasted, extends the time through which their discharge is to be distributed.

Peaked Hill, a conspicuous landmark on the north side of Melville Bay, introduces another transition of the coast phenomena, a reaction in some measure toward the conditions that prevail south of the Thumb. Peaked Hill is a cone set upon an irregular ridge, with black, rather ragged outliers in the vicinity. The whole combination has a very volcanic aspect, but there is little or nothing in this upon which to base an inference respecting its nature. Westward from Peaked Hill there are frequent protrusions of hill and mountain crests and ragged outliers, arranged in an irregular scattered way, but sufficiently thick to give the sea frontage quite as much the expression of a range of mountains with attendant glaciation, as of predominant glaciation interrupted by mountainous projections. The inland ice may be seen sufficiently through the gaps to show that it dominates the country immediately in the rear, and that the mountainous aspect is purely frontal. Frequent ice tongues come winding down between the hills to the sea, and to some extent glacial sheets wrap them about, while local glaciers and snow blankets cover portions of their slopes. The total expression is much more glacial than that of the land border south of the Melville ice wall.

Into the bay east of Cape York very considerable glacial tongues descend from the east, north and west. They push well out into the bay, which probably signifies that it is shallow. During the past season the ice did not move out of the bay (at least it had not at the time of our return, when the season of new ice was at hand) and hence all the icebergs recently discharged remained embedded in the stationary ice. Mr. Astrup informs me that the ice does not usually move out annually but remains for a period of years, and, partly by deeper freezing and partly by snow accumulations, acquires considerable thickness. When it is finally forced out it forms at least a variety, if not the typical variety, of "palæocrystic" floes. Mr. Astrup thinks that glaciers sometimes force such floes out.

Cape York is a promontory of ancient crystalline rock, standing at the junction of Melville Bay with the northern extremity of Baffin's Bay, where it narrows rapidly into Smith's Sound. From this point west-northwestward for some forty miles, the Crimson Cliffs present an abrupt plateau face, down the ravines of which creep a dozen small glaciers. The name "Crimson Cliffs" is variously attributed to the reddish lichens that grow upon the face of the rocks, and to the "red snow" (*Protococcus nivalis*) which in the latter part of the season gives a very notable pinkish tinge to the remnant snow banks and the granular surfaces of the glaciers. The glaciers take their origin in an undulatory nevé surmounting the cliffs. This appears to be continuous with the great snow cap of the interior, but from its apparent thinness and strong undulation in evident conformity to the rock surface, it seems probable that it is, in effect, a local ice cap. It is probable that the Cape York glaciers on the one hand and the noble Petowick glacier on the other, draw away and discharge the surplusage of the adjacent portion of the main ice cap, so that it does not push forward over the edge of the Crimson Cliffs. At any rate, the glaciers that creep down the face of the Crimson Cliffs are all small and give no hint of relationship to anything beyond the limited though rather considerable snow fields on the summits immediately above them. These little glaciers descend steeply, winding through their narrow valleys in full conformity to topographic demands. The most of them do not fully reach the sea level, but terminate at varying heights above it. A few actually protrude into the water, and have vertical frontal cliffs. Terminal and occasional medial moraines are present. There appears here an interesting phenomenon which was frequently

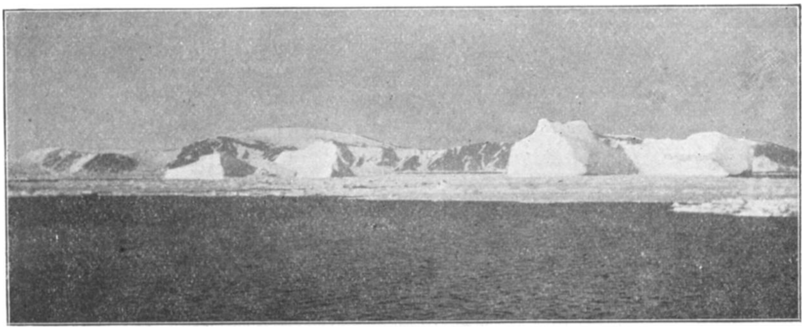

FIG. 15.—Distant view of the Crimson Cliffs, showing ice cap, glaciers, icebergs and ice floes.

noted farther northward — the construction of a causeway by the glacier through the accumulation of its own débris beneath it. In their upper parts the glaciers appear to fit snugly in their respective valleys, and they doubtless have carried along with themselves all débris that may have been loosened beneath them; but on reaching the lower gradients near the sea level much of this has been deposited, so that they are now creeping out on embankments of their own construction. It is perhaps not necessary to suppose that they have built these up actually beneath themselves, as they may have constructed them by successive terminal deposits. When shorter than they now are they may have thrown down their material at their front edges, and subsequently have advanced upon it, building out the terminal accumulation in front as they slowly advanced. Whatever be the explanation (and passing observation gave no data for determining the mode of construction), the interesting fact remains that the glaciers become subservient to their own accumulations, instead of forcing them bodily out of their way.

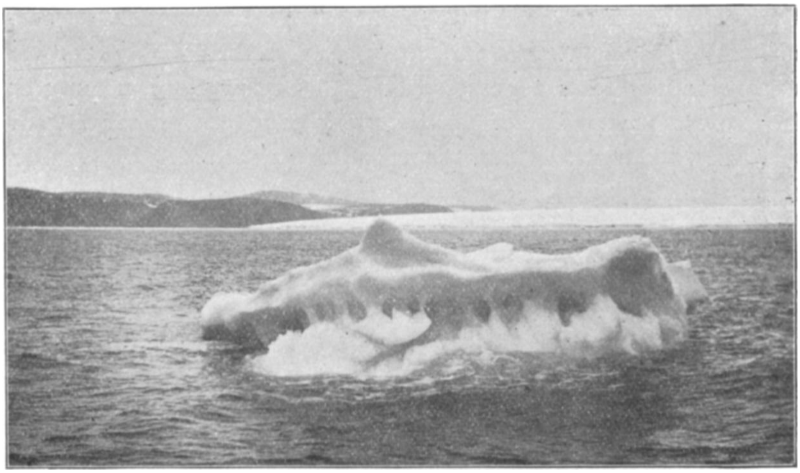

FIG. 16.—Distant view of a part of Petowik glacier. Ice mass in foreground showing cavernous melting at former water-line with subsequent tilting.

Near the western extremity of the Crimson Cliffs there stands, two or three miles off shore, a very notable island, known as Conical Rock. Its name indicates its form, but does not suggest the jaggedness of its surface, which is quite pronounced, and again raises the question whether the great ice sheet has ever passed much beyond its present limits.

A short distance beyond this, the Petowik glacier, the noblest of the isolated glaciers of this portion of the coast, presents itself. It has a breadth of seven miles, and arches forth gently into the bay. Its profile is singularly regular and rises gently as it stretches back from the edge of the sea cliff into the interior, where the glacier merges into the plains of the inland ice. Its transverse profile is a gentle arch with but slight convexity in the central part. The upper surface is comparatively free from crevasses, and nowhere in its course, so far as seen, did it show any cataracts. Its general expression is similar to that of the great Frederickshaab glacier of South Greenland, though it is much inferior to it in dimensions and impressiveness. The Petowik glacier appears to be relatively inert, discharging but few icebergs.

Between the Petowik glacier and Wolstenholme Sound, the coast is relatively free from snow and ice. In the depths of the Sound large glaciers descend to the sea level or to its vicinity, but only very distant and imperfect views of these were had. Dalrymple Island, in the mouth of the Sound, closely resembles Conical Rock in its form and surface ruggedness, and doubtless has the same significance. A photographic illustration of it has been given in the introductory narrative (Fig. 3). Saunders Island, which stands farther within the mouth of the Sound, introduces us again to stratified clastic rocks. These have been absent since we left the Disco region. From this point they stretch to Cape Alexander, at least, though they are not everywhere the border rock. So far as identified, they consist of sandstones and shales.

Along the shores of Granville Bay, and northward to Cape Parry, at the mouth of Inglefield Gulf, there are several glaciers of medium dimensions which descend from the ice cap of the plateau immediately above them, which is an extension of the inland ice. These glaciers, however, occupy only a small fraction of the coast, the greater portion of which is ice-free land. It differs from that of South Greenland in the important fact that it is a plateau border and not mountainous. The clastic rocks are rounded into soft contours, whether by long exposure to meteoric agencies or to glacial action is not evident at a distance, and need not be considered here, as this brings us to the entrance to Inglefield Gulf, where a closer examination will be possible.

This running sketch of passing observations has brought into imperfect view the various coastal types of West Greenland; rugged serrate mountains; rounded sub-mountainous tracts; coast-island fringes; ice-fields ending in sea cliffs; ice-fields struggling with mountainous protrusions; rock-walls capped with nevé and traversed by "hanging" glaciers; and plateaus of softened outline, surmounted by ice-fields whose tongues creep down wide and less steep valleys.

T. C. CHAMBERLIN.